Effect of different growing media and varying levels of gibberellic acid on seed germination and vigour of acid lime (*citrus aurantifolia* swingle.) cv.kagzi lime.

Abstract

The present investigation **"Effect of different growing media and varying levels of gibberellic acid on seed germination and vigour of acid lime (*Citrus aurantifolia* Swingle.) cv.Kagzi lime"** was laid out on the experimental site of Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences, Naini, Pryagraj (UP),during 2023. The present investigation was carried out in randomized block design with 13 treatment which were replicated thrice. The treatments were **T_0** (Control), **T_1** (Sand + FYM + GA3 150mg/l), **T_2** (Sand + FYM + GA3 200mg/l),**T_3** (Sand + FYM + GA3 250mg/l),**T_4** (Sand + Vermicompost + GA3 150mg/l),**T_5** (Sand + Vermicompost + GA3 200mg/l),**T_6** (Sand + Vermicompost + GA3 250mg/l),**T_7** (Sand + Coco peat + GA3 150mg/l),**T_8** (Sand + Coco peat + GA3 200mg/l),**T_9** (Sand + Coco peat + GA3 250mg/l),**T_{10}** (Sand + Coco peat + Vermicompost + GA3 150mg/l),**T_{11}** (Sand + Coco peat + Vermicompost + GA3 200mg/l),**T_{12}** (Sand + Coco peat + Vermicompost + GA3 + 250mg/l). On the basis of our experimental findings it can be concluded that the treatment T4 (Sand + Vermicompost + GA3 150mg/l) Was found to be best in the terms of germination percentage growth parameters and survival percentage of Acid lime.

Commented [I1]:

Keywords: FYM, Vermicompost, Coco peat, GA3, kagzi lime.

Introduction

The cultivation of acid lime (*Citrus aurantifolia* Swingle), commonly known as Kagzi lime, is of significant economic importance in many tropical and subtropical regions worldwide. This citrus fruit is esteemed for its tart flavor, aromatic qualities, and versatility in culinary and medicinal applications. Maximizing the yield and quality of acid lime crops is a primary concern for growers, necessitating research into various factors influencing seed germination and plant vigor. *Citrus aurantiifolia*, commonly known as acid lime, is a small evergreen tree belonging to the Rutaceae family.

Gibberellic acid, a plant hormone, plays a crucial role in regulating various physiological processes, including seed germination, stem elongation, and flowering. Understanding how different growing media and GA levels impact these processes in acid lime seeds can offer valuable insights for optimizing germination rates, seedling growth, and ultimately, crop yield. Gibberellic acid (GA3) exerts a crucial influence on seed germination by orchestrating various physiological and biochemical processes.

Farmyard manure (FYM), often referred to as "green manure," is a traditional organic fertilizer derived from decomposed animal waste, primarily from cattle, horses, sheep, or poultry. It is a valuable source of nutrients, organic matter, and beneficial microorganisms, making it an essential component of sustainable agriculture and soil management practices. FYM is rich in essential plant nutrients such as nitrogen (N), phosphorus (P), potassium (K), and micronutrients like calcium, magnesium, and sulfur.

Vermicompost is an organic fertilizer and soil amendment produced through the decomposition of organic materials by earthworms, typically species such as Eisenia fetida and Lumbricus rubellus. This process, known as vermicomposting, yields a nutrient-rich, humus-like material prized for its ability to improve soil health and enhance plant growth. The vermicomposting process begins by providing a suitable habitat for earthworms, often in containers or specialized vermicomposting systems.

Materials and Methods

The present investigation ~~**"Effect of different growing media and varying levels of gibberellic acid on seed germination and vigour of acid lime (*Citrus aurantifolia* Swingle.) cv.Kagzi lime"**~~ was laid out on the experimental site of Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences, Naini, Pryagraj (UP),during 2023. This study was conducted using a randomized block experimental design involving 13 treatments, each replicated three times~~The present investigation was carried out in randomized block design with 13 treatment which were replicated thrice.~~ The treatments were **T_0** (Control), **T_1** (Sand + FYM + GA3 150mg/l), **T_2** (Sand + FYM + GA3 200mg/l),**T_3** (Sand + FYM + GA3 250mg/l),**T_4** (Sand + Vermicompost + GA3 150mg/l),**T_5** (Sand + Vermicompost + GA3 200mg/l),**T_6** (Sand + Vermicompost + GA3 250mg/l),**T_7** (Sand + Coco peat + GA3 150mg/l),**T_8** (Sand + Coco peat + GA3

Commented [I2]: Claims must be supported by references; Provide factual context, a clearly defined problem, a proposed solution, a brief literature survey, and the scope and justification of the work done. (**Author Guidelines)**

200mg/l),**T_9** (Sand + Coco peat + GA3 250mg/l),**T_{10}** (Sand + Coco peat + Vermicompost + GA3 150mg/l),**T_{11}** (Sand + Coco peat + Vermicompost + GA3 200mg/l),**T_{12}** (Sand + Coco peat + Vermicompost + GA3 + 250mg/l). The research work was carried out the objective of growing media and gibberellic acid on germination and survival percentage of kagzi lime.

Results and Discussion

The effect different growing media and varying levels of gibberellic acid on seed germination of kagzi lime is very obvious and consistent. There was significant difference among the different treatments. Among the treatment applied the maximum seed germination percentage was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 85.07–% followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 83.12—% which was statistically superior over control T_0 (Control) with 72.36-%.

The effect different growing media and varying levels of gibberellic acid on seed vigor index of kagzi lime is very obvious and consistent. There was significant difference among the different treatments. Among the treatment applied the maximum seed vigor index was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 1538 followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 1408 which was statistically superior over control T_0 (Control) with 1055.—. Together, GA3 and vermicompost synergistically promote acid lime seed germination by regulating cellular processes, ensuring optimal conditions for germination, and providing essential nutrients and growth-promoting substances.

The maximum plant height of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (33.92) cm followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (33.82) cm and the minimum plant height was recorded in T_0 (control) with (23.01) cm. Gibberellic acid (GA3) plays a crucial role in increasing the plant height of acid lime at the cellular level. GA3 is a plant growth regulator that primarily stimulates cell elongation and division. At the cellular level, GA3 interacts with specific receptors in the cell membrane, initiating signal transduction pathways that activate genes responsible for cell elongation.

The maximum Number of leaves of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (16.87) followed by treatment T_5 (Sand +

Commented [I3]: it would be uninteresting to organize treatments in a table. (Author Guidelines)

Commented [I4]: The results and discussion are not referenced; the claims are not justified.

Vermicompost + GA_3 200mg/l) with (15.53) and the minimum Number of leaves was recorded in T_0 (control) with (11.53) . At the cellular level, GA3 interacts with receptors on the cell membrane, initiating signaling cascades that activate transcription factors responsible for leaf primordia formation. Additionally, GA3 stimulates the expression of genes encoding proteins crucial for leaf growth and expansion. By promoting cell division and expansion, GA3 facilitates the formation of new leaves.

The maximum Plant spread of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (8.08 and 7.76) cm followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (8.97 and 8.09) cm and the minimum Plant spread was recorded in T_0 (control) with (4.17 and 4.19) cm. At the cellular level, organic manure improves soil structure and nutrient availability, facilitating better root penetration and lateral root growth, which contribute to increased plant spread. Together, GA3 and organic manure synergistically promote cellular processes that enhance plant spread, leading to healthier and more vigorous acid lime plants with increased lateral expansion.

The maximum stem diameter of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (9.28) mm followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (9.09) mm and the minimum Stem Diameter was recorded in T_0 (control) with (8.25) mm. Gibberellic acid (GA3) and organic manure play integral roles in increasing the stem diameter of acid lime at the cellular level. GA3, a plant growth regulator, promotes cell elongation and division, influencing stem thickness. At the cellular level, GA3 interacts with receptors on the cell membrane, initiating signaling pathways that activate genes responsible for cell expansion and secondary growth. Organic manure, such as compost or vermicompost, enriches the soil with nutrients and beneficial microorganisms, supporting robust root development and overall plant vigor.

The maximum Leaf area of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (10.33) cm^2 followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (10.15) cm^2 and the minimum Leaf area was recorded in T_0 (control) with (8.92) cm^2. Organic manure, such as compost or vermicompost, enriches the soil with

nutrients and beneficial microorganisms, supporting vigorous plant growth. At the cellular level, organic manure enhances nutrient availability and metabolic processes, facilitating optimal leaf development and expansion. By synergistically promoting cellular processes, GA3 and organic manure enhance leaf area in acid lime plants, resulting in increased photosynthetic capacity and overall plant vigor.

The maximum Chlorophyll Content was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 5.44 followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 5.07 which was statistically superior over control T_0 (Control) with 3.29. Gibberellic acid (GA3) has a complex effect on chlorophyll. While it can stimulate leaf growth, which could indirectly lead to more chlorophyll production due to more leaf area, high GA3 concentrations can actually decrease chlorophyll content. This is because GA3 may trigger chlorophyll breakdown in favor of other pigments. So, GA3's role in chlorophyll content is dependent on factors like concentration and plant species.

The maximum Survival percentage was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 88.72 % followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 85.11 % which was statistically superior over control T_0 (Control) with 63.79 %. A winning combination for acid lime survival can be achieved with GA3 and organic manures. GA3, applied before sowing, acts like a germination booster, leading to more uniform and earlier sprouting, giving seedlings a crucial head start. Organic manures, like compost, enrich the soil with vital nutrients like nitrogen and phosphorus, while also improving water retention and aeration.

Conclusion

On the basis of our experimental findings it can be concluded that the treatment T4 (Sand + Vermicompost + GA3 150mg/l) Was found to be best in the terms of germination percentage growth parameters and survival percentage of Acid lime.

Table 1 Effect of different growing media and varying levels of gibberellic acid on Seed germination, seed vigour index, plan height, no. of leaves, plant spread, stem diameter, leaf area, chlorophyll content and- Survival percentage of kagzi lime.

Symbol	Seed Germination (%)	Seed Vigour Index	Plant height (cm)	No. of leaves	Plant spread		Stem diameter	Leaf area (cm^2)	Chlorophyll Content	Survival percentage
					N-S	E-W				
T_0	72.36	1055	23.01	11.53	4.17	4.19	8.25	8.92	3.29	63.79
T_1	80.45	1203	30.45	13.53	5.49	6.37	8.79	9.18	3.55	74.47
T_2	80.67	1367	32.66	13.49	5.39	6.28	8.44	10.02	3.65	76.57
T_3	82.82	1390	31.32	13.87	6.12	7.6	8.79	9.63	3.73	75.37
T_4	85.07	1538	33.92	16.87	8.08	7.76	9.28	10.33	5.44	88.72
T_5	83.12	1408	33.82	15.53	8.97	8.09	9.09	10.15	5.07	85.11
T_6	81.00	1300	31.09	12.20	7.27	6.21	8.62	9.27	4.63	78.39
T_7	82.67	1242	29.93	14.20	7.69	6.47	8.50	9.21	4.04	80.02
T_8	79.87	1276	32.86	14.53	7.9	6.54	8.75	9.41	3.83	79.58
T_9	81.32	1313	32.26	14.20	6.93	6.78	8.71	9.44	3.68	82.62
T_{10}	79.63	1358	32.32	15.29	5.88	6.69	8.70	9.55	4.00	78.73
T_{11}	80.65	1387	31.64	14.87	7.28	7.49	8.77	10.04	3.87	78.97
T_{12}	82.43	1398	33.45	14.64	7.46	7.13	8.79	9.85	3.97	76.98
F-Test	S	S	S	S	S	S	S	S	S	S
$SEd_{(\pm)}$	1.04	36.87	0.059	0.085	0.026	0.024	0.039	0.18	0.220	0.220
$CD_{@5\%}$	2.19	73.74	0.118	0.175	0.054	0.051	0.078	0.453	0.643	0.643
CV	4.16	110.61	0.177	0.255	0.078	0.072	0.117	0.576	0.965	0.965

Commented [I5]: This table is not referenced in the text.

Commented [I6]: In the methodology, it is necessary to describe these parameters to enable a better understanding of your work

References

Abirami K, Rema PA, Mathew. Effect of different propagation media on seed germination, seedling growth and vigour of nutmeg. J of Medicinal plants Research 2010;4(19):2054-2058.

Adhikary S. Vermicompost, the story of organic gold: A review. Agricultural Sciences. 2012;3(7):905-917.

Arvind K, Ritesh, Patel KM, Upadhyay NV. Effect of different growing media and containers on germination and establishments of seedlings of papaya (*Carica papaya* L.) cv. *Madhubindu. Trends in Biosciences*, 2015;8(1):227-235.

Bhardwaj RL. Effect of growing media on seed germination and seedling growth of papaya cv. 'Redlady'. *Academic Journal* 2008;8(4):178-184.

Bisla SS, Singhrot RS, Chauhan SS. Effect of growing media on seed germination and growth of Ber. *Haryana Journal of Horticultural Science*.

Choudhary BK, Chakrawar VK. Effect of seed treatment using some chemicals on shoot and root growth of Rangpur Lime. *J Maharastra Agric. Univ*. 1982;1(1):66- 60.

Dayeswari D, Rayaprolu S, Jone A. Effect of potting media on seed germination, seedling growth and vigour in TNAU papaya Co.8. *International Journal of Pure and Applied Biosciences* 2017;5(3):505-512.

Farooqui AA, Nalawadi UG, Sulladmath UV.. Effect of growth regulators on the germination of sapota (Achras zapota Mill foseberg) seeds. *The Mysore Journal of Agricultural Sciences*. 1991;5:341-343

Joshi PS, Sahoo AK, Bhoyar RK, Meshram PC. Effect of various plant growth promoting substances on seedling growth of acid lime. *Trends in Biosciences* 2015;8(19):5222-5225.

Radha TK, Ganeshamurthy AN, Mitra D, Sharma K, Rupa TR, Selvakumar G. Feasibility of substituting cocopeat with rice husk and saw dust compost as a nursery medium for growing vegetable seedlings. *The Bioscan.* 2018;13(2):659-663.

Ramteke V, Paithankar DH, Ningot EP, Kurrey VK. Studied on effect of GA3 and propagation media on germination, growth and vigour of papaya cv. Coorg honey dew. *The Bioscan* 2015;10(3):1011-1016.

Shamet GS, Chauhan PS, Sood R. Nursery – studies on potting mixture, mulching and fertilizer requirements of chilgoza pine. *Indian Journal of Forestry* 1994;17(3):225- 229.

Yadav RK, Jain MC, Jhakar RP. Effect of media on growth and development of acid lime (Citrus aurantifolia Swingle) seedling with or without Azotobacter. *African Journal of Agricultural Research*. 2012;7(48):6421-6424.

Commented [I7]: These references are not included in the text. (Author Guidelines)